

1

VEHICLE MOUNTED DEVICE AND A METHOD FOR TRANSMITTING VEHICLE POSITION DATA TO A NETWORK-BASED SERVER

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an apparatus and method for ascertaining the position, velocity and direction of travel of a vehicle at a remote location and for transmitting such information to a network-based server using a wireless communication system.

2. Description of the Related Art

Various apparatus and methods for ascertaining the position of individual vehicles and for communicating that information to a user at a location remote from said vehicles are known in the art. For example, U.S. Pat. No. 5,043,736 to Darnell, et al., discloses a cellular position locating system for ascertaining the latitude and longitude of an individual or object at a remote location and transmitting such information to a base station using a portable hand-held remote unit. The portable unit includes a receiver circuit for use with a satellite navigation system, a microprocessor for analyzing coded signals, cellular phone and modem circuits for transmitting encoded signals to a base station and a time of day clock. The base station includes a computational system for decoding position data and a visual display device for presenting the remote unit map coordinates.

In U.S. Pat. No. 5,742,509, Goldberg, et al., discloses a personal tracking system integrated with a base station. The tracking system includes a remote unit that includes a location determination means, a microprocessor, a modem, and a communication means connected to the modem. The base station includes a computer with software and a modem. The remote unit and the base station communicate with one another through a communication link.

In U.S. Pat. No. 6,131,067, Girerd, et al., discloses a client-server computer network and the use of such a network to access remote sensors having associated position determination sensors. In one embodiment of the invention, a remote sensor transmits positioning data to a server where it is analyzed to derive the location of the remote sensor. The location so determined is then transmitted from the server to the client and is displayed at the client so that the user can identify the location of the remote sensor. Use of the Internet as the client-server computer network is disclosed, along with use of a web page at the server having means for the user to identify a particular remote sensor.

The available means with which to determine the position of a remote sensor, or of a plurality of remote sensors, can be improved upon. For instance, there is a need to reduce the elapsed time that is presently required of a user in determining the position of each vehicle of a fleet of vehicles—e.g., each rental car of a fleet of rental cars or each truck of a fleet of transportation trucks. The present invention improves upon the currently available means for determining the several positions of a plurality of remote sensors by combining a fully integrated remote positioning sensor with currently available high speed telecommunications networks. The fully integrated remote positioning sensor carries out all position determining calculations, including and desired differential corrections and auxiliary calculations, on-board at the remote location. This enables all position

2

and tracking data to be readily available for continuous or intermittent transmission of said data to a network-based server for data-basing the positional information. The data-based information is then available, on demand, when a user accesses the server to view positional information with regard to one or a plurality of vehicles. This obviates the need for polling the remote vehicle and substantially reduces the time required to access the positional information.

The device is also configured to store data on-board at the remote location during periods that the device is outside the communication range of a wireless network, and to automatically transmit the stored data as soon as the device returns to within the communication range of the wireless network. This last feature permits a history of the vehicle route and speed, etc., to be preserved for periods in which the vehicle is outside the communication range of the wireless network.

SUMMARY OF THE INVENTION

A vehicle mounted device is configured to transmit vehicle position data to a network-based server using a wireless communication system. A preferred embodiment of the device includes first and second processing modules carried by a vehicle. The first processing module includes a positioning system receiver configured to receive positioning signals from at least one source remote from said vehicle and to process said positioning signals into vehicle position data representing date and time, and the position, velocity and direction of travel of the vehicle.

The second processing module includes a data storage device configured to store the vehicle position data, a wireless communication system link for connecting the second processing module to a wireless communication system, and a processor configured to control intermittent transmission of the vehicle position data to the wireless communication system link for subsequent transmission over the wireless communication system and, finally, to a network-based server. The processor is further configured to control transmission of said position data to and from the data storage device, and to process incoming data sent from the network-based server.

In a preferred embodiment, the processor is a microcontroller that includes an erasable programmable read only memory ("EPROM") and a random access memory ("RAM"). The data storage device is an electrically erasable programmable read only memory ("EEPROM") or, more generally, an electrically erasable programmable memory. The positioning system receiver is a global positioning system ("GPS") receiver in communication with, preferably, four or more GPS satellites. The wireless communication system is selected from the group consisting of wireless LAN/WAN (local area network/wide area network), AMPS (advanced mobile phone system), Satellite (satellite based system communication system), iDEN™, TDMA (time division multiple access), CDMA (code division multiple access), CDPD (cellular digital packet data) and GSM (group special mobile) infrastructures, while the network-based server is a computer connected to a network, such as the Internet, that can be accessed through a web-browser by a user logged on to the Internet. Alternative embodiments include use of the present invention with Intranet type networks.

A power supply powers the first and second processing modules. A first cable conducts power from the power supply to the second processing module. A second cable conducts power from the second module to the first module,

3

and transmits vehicle position data from the first processing module to the second processing module.

The wireless communication system link is a wireless telephone, removably connected to the second processing module, and configured to transmit the vehicle position data over the wireless communication system to a network-based server. Alternative embodiments include use of wireless links between the second processing module and the wireless telephone, rather than removable connections. The processor is configured to establish a wireless communication between the wireless telephone and the network-based server upon start-up of the device. The processor is also configured to control transmission of the vehicle position data at predetermined periodic intervals during normal operation.

During an interruption in the wireless communication, the processor is configured to cease transmission of the vehicle position data and, rather, direct the data to be stored in the on-board storage device. The processor is also configured to periodically attempt to reestablish the wireless communication between the wireless telephone and the network-based server during such interruption. The processor is further configured to retrieve the data from the storage device and transmit it over the wireless communication system to the network-based server following reestablishment of the wireless connection.

The second processing module further includes at least one sensory input connected to the processor, where such sensory input is connected to an event sensor carried by the vehicle. The event sensor is configured to detect the occurrence of an event involving the vehicle and to transmit information regarding the event to said sensory input for processing by the processor.

A software program is configured to control initialization of the processor and the storage device upon start-up of the vehicle mounted device. The program is further configured to control enabling of interrupts and to check for the presence and functionality of all hardware and the operational mode of the vehicle mounted device. Finally, the program is further configured to control loading of operational setup parameters stored in said storage device and to check for the presence of vehicle position data stored in the storage device.

The periodic transmission of the vehicle position data is based on predetermined distance intervals, time intervals, polling, speed triggers, vehicle stop, vehicle start, or signals from the sensory inputs. The first and second modules are positionable within first and second housings, respectively, and the power supply means is a plug configured for insertion into a vehicle cigarette lighter. Alternatively, the power supply means may be a wire directly connected to the vehicle storage battery or fuse box.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings which illustrate the preferred embodiments of carrying out the invention:

FIG. 1 is a block diagram of a preferred embodiment of the device of the present invention;

FIG. 2 is a block diagram of the vehicle mounted device of the present invention in communication with a network-based server using a wireless communication system;

FIG. 3 is a flowchart depicting the basic operational steps of a preferred embodiment of the device of the present invention.

FIG. 4 is a second flowchart depicting operational steps of a second preferred embodiment of the present invention.

4

FIG. 5 is a block diagram of the preferred embodiment of the present invention showing a wireless connection between the vehicle mounted device and the wireless phone or modem.

DETAILED DESCRIPTION

Referring to FIG. 1, a preferred embodiment of the vehicle mounted device 5 includes a first processing module 10, a second processing module 20, and a wireless communication system link 30. The first processing module 10 includes a global positioning system ("GPS") receiver 40 for receiving and processing satellite signals into vehicle position data. The second processing module 20 includes a processor 60, an electrically erasable programmable read only memory ("EEPROM") 70 or, more generally, an electrically erasable programmable memory, at least one RS-232 driver 80, at least one sensory input 90, and a light emitting diode ("LED") display 100. Wireless communication system link 30 is a wireless phone 110, which is removably attached to the second processing module 20 through a connector means 115. An alternative embodiment includes use of a wireless link between the second processing module and the wireless communication system link 30. Referring to FIG. 5, an alternative embodiment includes the use of a wireless link between second processing module 20 and wireless phone or modem 110. The wireless link may consist of a Bluetooth Chipset and built-in antenna housed within second processing module 20 and a compatible Bluetooth Chipset and built-in antenna housed within wireless phone or modem 110. Said wireless link, shall adhere to the Bluetooth standard for wireless communication between Bluetooth enabled devices.

Power supply 150 provides power to second module 20 through power supply cable 140. Power is supplied to wireless phone 110 through an on-board storage battery typical for wireless telephones, and power is supplied to GPS receiver 40 through power conductor means 135 in cable 130. Data communication between first module 10 and second module 20 is provided through data bus means 137, which are contained in cable 130, and data communication between wireless phone 110 and second module 20 is provided through data bus means 117, which are contained in cable 120.

More specifically, a preferred embodiment of the vehicle mounted device 5 includes:

- (i) a 24 MHz, 8-bit CMOS Microcontroller, PIC17C256A, 68-pin PLCC for processor 60;
- (ii) a 256K-bit serial EEPROM, 8-pin SO1C for EEPROM 70;
- (iii) four +5V RS-232 Transceivers, 24-pin SSOP for RS-232 driver 80;
- (iv) four LED's for indicating GPS status, phone status, wireless coverage and power status for display 100;
- (v) a DB-9 male connector for an RS-232 connection to the phone for connector means 115; and
- (vi) a Garmin, 12-channel GPS receiver, model GPS35-HVS for GPS receiver 40.

Referring now to FIGS. 2 and 3, GPS receiver 40 is configured to receive signals 260 from satellites 200 and to convert said signals into vehicle position data, which includes data representing the date and time, the number of satellites tracked, the GPS lock status, and the vehicle position, velocity and direction of travel. GPS receiver 40 is further configured to transmit 380 said data to processor 60 following processing of signals 260 into vehicle position

5

data. Processor 60 is configured to then transmit the vehicle position data, along with any status data representing the status of sensory input 90, to wireless phone 110 for transmission to network server 230. Processor 60 is further configured to make such communications intermittently, depending upon whether the value of the time or distance parameters that are stored in EEPROM 70 are satisfied 370.

The operation of vehicle device 5 commences when the device receives power from power supply 150, which is supplied to device 5 through power cable 140. Upon receiving power, processor 60 is initialized. Processor 60 then checks for the presence and functionality of all hardware contained in device 5, and then loads the setup parameters in EEPROM 70, which include the host IP and port address, the dial string, the Internet Service Provider ("ISP") phone number, user name and password, the time and distance reporting rates for both in and out of coverage reporting, the speed trigger, the sense input trigger, and enablement and disablement triggers. Following loading of setup parameters, device 5 attempts to establish a wireless connection over wireless communication system 210 to server 230 for automatic, but intermittent, transmission of vehicle position data. A point-to-point protocol ("PPP") connection is established between second module 20 and wireless phone 110 using a packet data or circuit-switched connection depending on the wireless communications system 210. Once the PPP connection is established, vehicle position data updates are transmitted, intermittently, each time one of the configured timers, either time or distance, has expired 370. At that time, a vehicle position data update is constructed as a User Datagram Protocol ("UDP") packet and transmitted over the wireless communication system 210 to server 230.

Referring still to FIGS. 2 and 3, processor 60 is configured to intermittently transmit 300 the vehicle position data to wireless phone 110 during periods when wireless phone 110 is in communication 310 with server 230. Wireless phone 110 then communicates the vehicle position data over wireless communications system 210 to network 220. Network 220 communicates the data through network service provider 240 to server 230. It is noted that wireless communication system 210 may be selected from the group of infrastructures that include wireless LAN/WAN (local area network/wide area network), AMPS (advanced mobile phone system), Satellite (satellite based system communication system), iDEN™, TDMA (time division multiple access), CDMA (code division multiple access), CDPD (cellular digital packet data) and GSM (groupe special mobile) infrastructures. It is further noted that server 230 is configured to communicate with, and store vehicle position data received from, a plurality of individual vehicle mounted devices 5. In a preferred embodiment of the invention, network 220 is the Internet, although an alternative embodiment may have an Intranet as network 220.

During periods when wireless phone 110 is not in communication 320 with server 230—e.g., when wireless phone 110 is disconnected or out of coverage of wireless communication system 210—processor 60 directs the vehicle position data to EEPROM 70 for storage 330 until wireless phone 110 is able to reestablish communication with server 230. Processor 60 is configured to store said data sequentially in EEPROM 70 for subsequent retrieval 350. Use of a 256-K Bit Serial EEPROM, such as is used in a preferred embodiment, permits storage of up to 509 GPS positions in EEPROM 70. In the event all 509 storage locations are filled during a period when communication is not established 320, processor 60 is configured to overwrite the least recent data

6

entries with current data entries. Once wireless phone 110 reestablishes communication with server 230, processor 60 retrieves 350 the vehicle position data stored in EEPROM 70 and transmits it to wireless phone 110 for subsequent communication 360 of said data over wireless communication system 210 to network 230.

Further referencing FIGS. 2 and 3, a user with access to a computer and network browser—USER "A" 250, for example—logs on to network 220 through network service provider 256 and accesses server 230. USER "A" 250 is then able to view the vehicle position data for a single vehicle or for a fleet of vehicles. Wireless phone 110 is also configured to receive messages sent by server 230 and to direct those messages back to processor 60. This permits USER "A" 250, for example, to communicate messages like Internet Control Management Protocol Echo ("ICMP") ping messages, configuration messages, or poll messages to wireless phone 110, which is configured to transmit those messages to processor 60.

Receipt by device 5 of poll message 390 allows the user to request an immediate position update be determined and transmitted 305 from vehicle device 5 to server 230. Receipt by device 5 of configuration message 315 allows the user to change and reload 325 the setup parameters stored in EEPROM 70. For example, configuration message 315 allows the user to change and reload 325 the setup parameters in order to change the interval at which data is transmitted 370 from device 5 to server 230. Processor 60 is further configured to respond 335 to a configuration inquiry 345 from server 230 regarding the current configuration of parameters stored in EEPROM 70.

It is noted that processor 60 is configured to operate using a software program that controls initialization of said processor and said storage device upon start-up of said vehicle mounted device, that controls enabling of interrupts and checking for the presence and functionality of all hardware and operational modes of said vehicle mounted device, and that controls loading of operational setup parameters stored in said storage device and checking for the presence of vehicle position data stored in said storage device.

A preferred embodiment of the invention also enables indirect addressing to be used in the vehicle positioning process. For example, when vehicle position data is transmitted to a network-based server over a wireless network, a wireless carrier may translate the IP address ("Internet protocol address") that identifies the transmitting wireless communication system link—e.g., the wireless phone or modem—making it difficult or impossible to data-base the vehicle position data accurately. For devices and methods that depend on the IP-address of the wireless phone or modem to identify the vehicle mounted device, an identification problem can result. In order to overcome the problem, processor 60 is further configured to add an identification code to the vehicle position data and transmit the identification code along with the vehicle position data. The identification code is identified by the network-based server, enabling the vehicle position data to be data-based at the network-based server consistent with the transmitting vehicle mounted device. This further enables the device to be used with several different phones and wireless carriers, regardless of whether the carrier translates the IP-address code or not. In other words, this feature allows use with wireless systems that implement a firewall between their network and the Internet, where the wireless systems provider translates the provisioned IP address in the wireless phone or modem to a "Routable" IP address on the Internet. This feature further allows the vehicle mounted device to be